Dual Carrier

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Two simultaneous (dual) uplink carriers from a single DSN 64-m-diameter antenna site are required to support the Viking 1975 project. A prototype dual-carrier exciter has been built and tested. The dual-carrier exciter amplifies and combines two standard DSN exciter signals, which are used to drive a high-power klystron operating in a linear mode (10% of normal power). The measured intermodulation products produced were at least 20 dB below the carrier's power.

I. Introduction

The Viking 1975 project requires two (dual) S-band signals to be transmitted to the orbiters and/or landers from a single DSN 64-m-diameter antenna site. The dual signals will be produced by combining two exciter signals and amplifying them with a high-power klystron. The power of each carrier in the dual mode will be limited to 10% of the maximum output of a single carrier (i.e., 400-kW transmitter limited to 40 kW per dual carrier) in order to operate the klystron amplifiers in a linear mode.

II. Test Configuration

Dual-carrier tests were conducted at DSS 14 using DSN Block IIIC exciter chains, a prototype dual exciter-combiner unit, the 400-kW transmitter, and the antenna (Fig. 1). The results were monitored at two points, one at the output of the 400-kW transmitter using the forward coupler of the transmitter (A), and a second probe on the surface of the dish (B). A spectrum analyzer with a YIG preselector was used to analyze the dual output. Balanced and unbalanced carriers (40/40 kW, 40/20 kW, 40/10 kW, 10/40 kW, etc.) were investigated.

III. Test Results

The dual-carrier intermodulation products were down at least 20 dB below those of the lowest carrier. A typical output spectrum for two 40-kW carriers and the intermodulation products is shown in Fig. 2. Figures 3 and 4 show typical 40- and 20-kW, and 40- and 10-kW carriers, respectively, with their intermodulation products.

IV. Hardware

Figure 5 shows a detailed block diagram of the dual-carrier exciter. The 66-MHz filters are used to remove

any spurious signals from the ×3 phase modulator. The multipliers (×4, ×8) are standard DSN Block IIIC modules. The mechanical attenuator sets the drive level to the 10-W amplifier. The electronics switch is used for time multiplexing. (After the dual-carrier exciter was built, it was decided to use frequency multiplexing only.) The 10-W amplifier (Ref. 1) is used to raise the exciter power to 10 W. The single-pole double-throw (SPDT) coax switches are used in conjunction with the transfer switch to drive either the 400- or 20-kW transmitter with either of the exciters, or to drive the 400-kW transmitter with a dual carrier. The electronic attenuators balance the dual carriers, and the circulators provide added isolation between dual channels. The ring hybrid combines the two exciter carriers to form the dual carriers. The couplers are used in conjunction with the power monitors to evaluate the subsystem performance.

V. Conclusion

The prototype dual-carrier exciter has demonstrated that two carriers can be combined and amplified by a high-power klystron. Output levels of 10% per carrier of the total output power of the klystron can be easily achieved. The intermodulation products are at least 20 dB below the carriers. Further evaluation and investigation are being carried out.

Reference

1. Smith, R. H., "10-W S-Band Amplifier," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. IX, pp. 196–200, Jet Propulsion Laboratory, Pasadena, Calif., June 15, 1972.

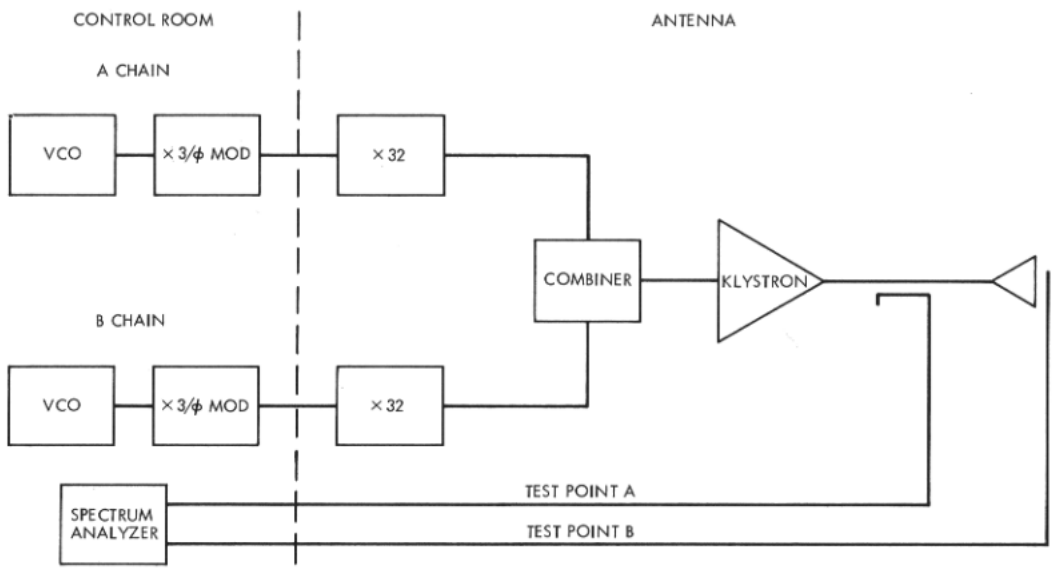
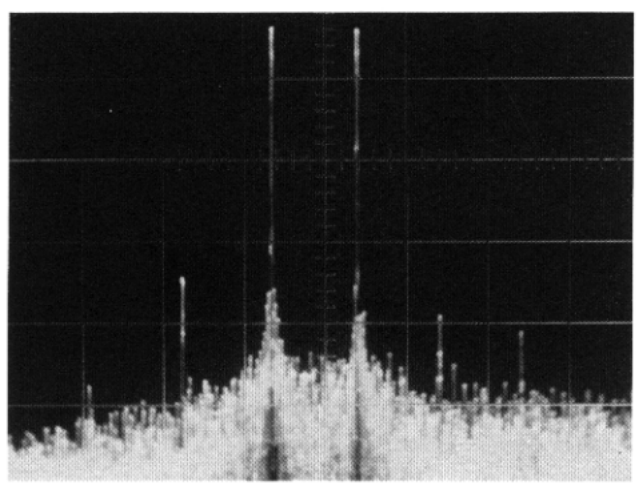


Fig. 1. Dual-carrier test at DSS 14



10 dB/cm

Fig. 2. Dual carrier, 40 kW each

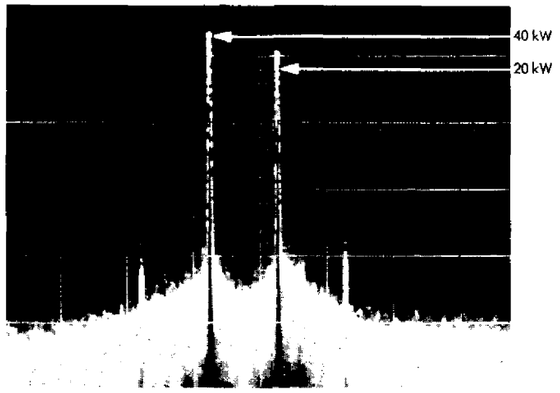


Fig. 3. Dual carrier, 40 and 20 kW

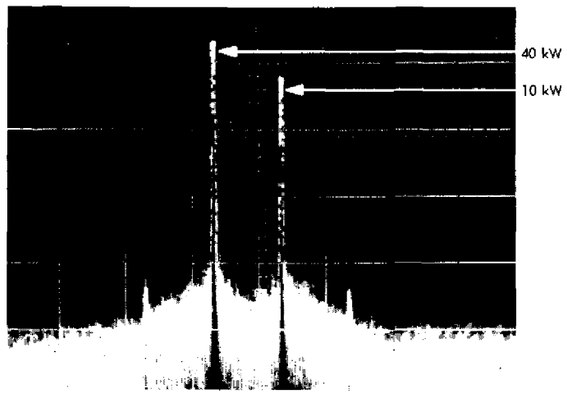


Fig. 4. Dual carrier, 40 and 10 kW

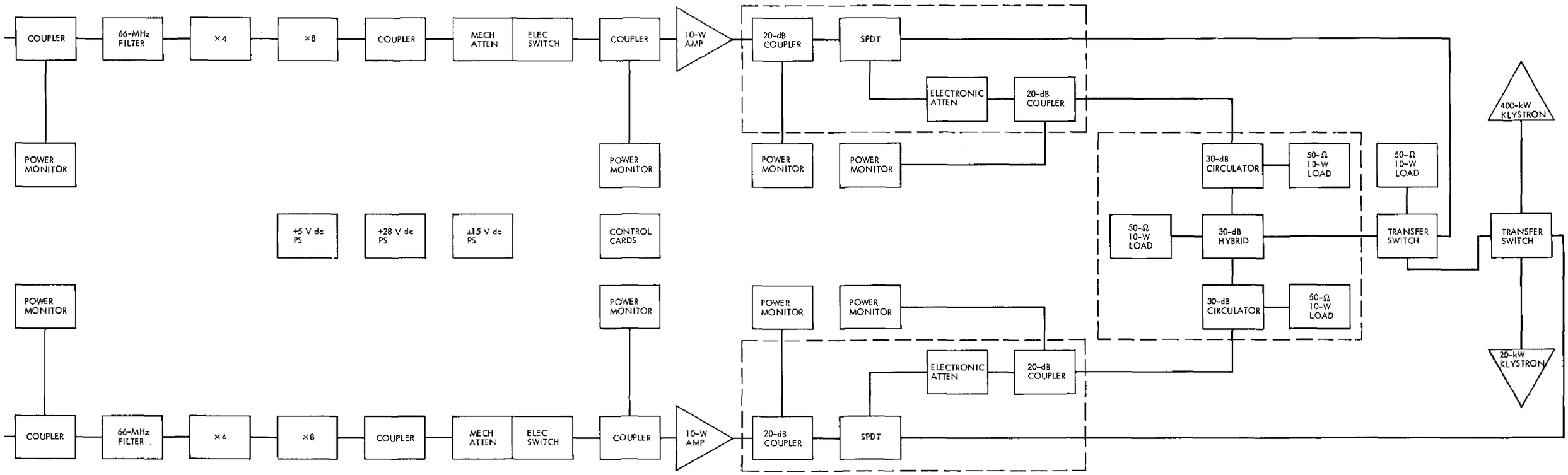


Fig. 5. DSS 14 prototype dual-carrier exciter